The Canada Oil and Gas Lands Administration

Annual Report
1990

Corporate Profile

The Canada Oil and Gas Lands Administration (COGLA) was established in 1981 by a memorandum of understanding between the Minister of Energy, Mines and Resources and the Minister of Indian Affairs and Northern Development.

COGLA is the federal government's principal contact with the oil and gas industry in matters relating to the regulation of oil and gas activity on Canada's frontier lands. These lands include Yukon Territory, the Northwest Territories, Hudson Bay and most of the country's offshore areas. The Canada-Newfoundland Offshore Petroleum Board has operational responsibility for the Newfoundland and Labrador offshore. The Canada–Nova Scotia Offshore Petroleum Board has operational responsibility for the Nova Scotia offshore.

COGLA's prime responsibility is to regulate the exploration for, and the development and production of, oil and gas on areas of the frontier lands not under accord legislation. This responsibility is carried out in a manner that promotes safety of the worker, effective resource conservation, environmental protection, and full and fair access for Canadians to benefits and opportunities. COGLA also advises the federal energy minister on petroleum accord issues. COGLA has five branches:

- Rights Management Branch
- Engineering Branch
- Resource Evaluation Branch
- Environmental Protection Branch
- Policy Analysis and Coordination Branch

COGLA's Yellowknife office has operational responsibility for the northern offshore and onshore areas. This office regulates the geological, engineering, occupational safety and Canada benefits aspects of oil and gas exploitation activities by issuing authorizations to drill wells, by monitoring reports and other data submitted on operations, and through regular on-site inspections.

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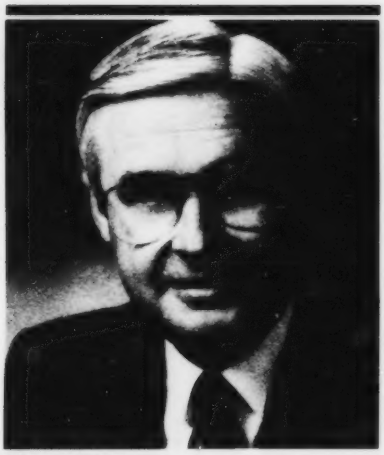
Message from the Minister of Energy, Mines and Resources, The Honourable Jake Epp



Minister Jake Epp

It is my pleasure to submit to Parliament the ninth annual report of the Canada Oil and Gas Lands Administration (COGLA).

1990 was a watershed year for the development of Canada's frontier hydrocarbon reserves. After years of planning and discussions by governments and industry, decisions were taken to proceed with the Hibernia and Cohasset-Panuke oil projects on the East Coast.

The joint management and revenue-sharing arrangements established in the second half of the 1980s by the federal and provincial governments provided the firm foundation upon which these decisions could be taken. This accomplishment should not be overlooked, for without the Atlantic and Nova Scotia accords and the joint management boards established under the accords, it would not have been possible to move ahead with these projects.

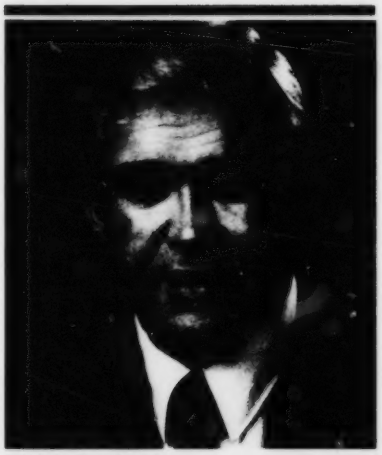
Hibernia and Cohasset-Panuke will have a significant impact on the development and growth of the Canadian offshore industry. They are only the first steps toward the development of the new skills, expertise and technologies required to meet the future challenges of frontier oil and gas development. These projects will place Canadians at the leading edge of offshore technologies, ready to compete for other opportunities at home and in foreign markets. With a modern infrastructure and work force in place, the stage will be set for other offshore projects, such as Terra Nova, Whiterose and Venture.

All environmental assessments for the Hibernia and Cohasset-Panuke development projects have been completed by the Government of Canada under the Environmental Assessment Review Process (EARP) guidelines order. The government is satisfied that these projects can proceed based on the environmental conditions established by the offshore petroleum boards.

To have seen these achievements come to fruition in such a short period of time is clear testimony to the energy and dedication that COGLA employees have consistently demonstrated during the past several years. As the government begins to implement its decision to reintegrate COGLA's operations into its parent departments and the National Energy Board, I am confident that COGLA employees will continue to perform the vital functions of managing Canada's interests in its frontier regions with the same high standards of commitment and professionalism.

The 1990s hold great promise for a new and challenging period in the history of frontier oil and gas development in Canada. The work to bring Canada's frontier petroleum resources to market in significant amounts is now under way. I am confident that Canadians will rise to the challenges ahead as they work together to make frontier production a reality.

Message from the Minister of Indian Affairs and Northern Development, The Honourable Tom Siddon



Minister Tom Siddon.

I am pleased to join my colleague, the Honourable Jake Epp, Minister of Energy, Mines and Resources, in tabling before Parliament the ninth annual report of the Canada Oil and Gas Lands Administration (COGLA).

As many of you are aware, steps are being taken to wind up COGLA. Responsibility for the regulation of drilling and production operations in the North, the administration of oil and gas rights and other policy-related matters previously handled by COGLA will be moved to the National Energy Board, Indian Affairs and Northern Development, and Energy, Mines and Resources.

I would like to take this opportunity to congratulate COGLA employees on their hard work and dedication. The past decade has been an active and challenging period for frontier exploration and COGLA has made a significant contribution to oil and gas regulation during that time. Their contribution has led to the changes that are now being put in place.

This action does not alter the commitment of the Government of Canada to the Frontier Energy Policy and to the Atlantic and Nova Scotia accords. Similarly, the government remains committed to the *Northern Political and Economic Framework* and the northern accord agreements in principle which were signed with each of the territorial governments in September 1988. The restructuring of oil and gas functions will support these objectives.

Reviewing the events of the past year, a number of issues come to mind. My government's commitment to a cooperative and regular rights issuance process was demonstrated in March when three exploration licences were issued to industry for lands in the central Beaufort Sea. This rights issuance completed the call for bids issued in 1989 following consultations with territorial governments and the Inuvialuit. After similar consultations this year, a call for nominations of lands in the western Beaufort Sea was announced in April. Although no nominations were received from industry, calls will continue to be held on a regular basis.

Concerns about oil and gas exploration activities were raised during the Environmental Impact Review Board (EIRB) public hearings in June 1990, on a proposed drilling program in the Beaufort Sea. In light of the wide-ranging observations contained in the EIRB's report, I asked Robert Hornal to act as chairperson of the Beaufort Sea Steering Committee to look at the concerns highlighted during the board's hearings. The government's support for the work of the EIRB and of the steering committee is another reflection of the commitment to ensuring that oil and gas activities are conducted in a manner that is safe and sensitive to the environment. I requested that the Steering Committee provide me with its finding in early 1991. These findings will provide a valuable contribution to the organizational reform now under way.

This has been a significant year for all concerned with drilling operations in the Beaufort Sea and other northern areas. I look forward to working with all stakeholders in bringing about the development of our northern oil and gas resources.

Let me once again extend my thanks and gratitude to all the employees of the Canada Oil and Gas Lands Administration.

Canada's Frontier Lands

Area under the responsibility of the Minister of Energy, Mines and Resources

Area under the responsibility of the Minister of Indian Affairs and Northern Development

A Statement from COGLA's Administrator, Maurice Taschereau

Maurice Taschereau.

For the second year in a row, frontier oil and gas exploration activity was focused in the northern region. Of the 15 wells terminated on the frontier lands, 14 were in the North, with 12 wells on the Mainland Territories and 2 in the Mackenzie Delta–Beaufort Sea area. On the East Coast, one well was drilled offshore Newfoundland near the Terra Nova oil discovery. Twenty-four geophysical and geological programs were conducted on the frontier lands during 1990, with an increase of activity in the East Coast offshore and a substantial decrease of activity in the North compared with 1989.

In March, three exploration licences were awarded as a result of a call for bids in the central Beaufort Sea. The licences are the first new exploration rights issued in the Beaufort Sea in more than two decades. A call for nominations for exploration rights in the western part of the Beaufort Sea was issued in April but did not result in any lands being nominated by industry.

COGLA continues to ensure that oil and gas exploration and development activities on Canada's frontier lands are carried out in an environmentally safe and sound manner. We conducted four major interdepartmental environmental reviews under the federal Environmental Assessment and Review Process (EARP) guidelines on proposed projects on the East Coast. Three of them were related to the Hibernia project, and the fourth was a review of the development plan application for the Cohasset-Panuke project. Based on this work, COGLA recommended to the Minister of Energy, Mines and Resources that the projects proceed.

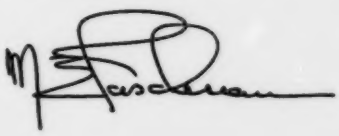
An extensive technical review and EARP screening of the proposed Gulf Canada Resources Ltd. *Kulluk* drilling program application (DPA) for 1990-92 was nearing completion at year-end. As part of our review of Gulf's DPA, we received in June the Environmental Impact Review Board (EIRB) decision report on the Gulf application. EIRB recommended that we not approve the program because of concerns about industry and government's ability to respond to an oil spill from a blowout in the Beaufort Sea. A special steering committee has been examining the issues raised by EIRB and will be reporting to the Minister of Indian Affairs and Northern Development in 1991.

Through the year, we continued our consultations with the accord provinces, territorial governments, the offshore petroleum boards and industry on various regulatory initiatives. As a result, the Canada Oil and Gas Production and Conservation Regulations were promulgated in November. These regulations cover procedures and approvals for the orderly and efficient development and production of hydrocarbon resources on the frontier lands. Similar regulations were drafted for the Newfoundland and Nova Scotia offshore regions. The Newfoundland Offshore Petroleum Drilling Regulations were published in *The Canada Gazette, Part I*, and are expected to be promulgated in 1991. The Nova Scotia version of these regulations was also drafted during the year.

Dialogue with territorial governments, native groups and industry is an integral part of the regulatory process. In November, COGLA and the Beaufort Sea Oil Spill Cooperative sponsored a workshop in Inuvik on oil spill cleanup and related matters as a means of enhancing contingency planning awareness in the North. Meetings to formalize community representation in the contingency planning and response team structure will be convened in 1991.

Following a recommendation to oil and gas operators in COGLA's 1989 report on the Immiugak N-05 shallow gas incident, we organized and chaired a workshop in Calgary on shallow drilling hazards in the Beaufort Sea–Mackenzie Delta region. The workshop reviewed and assessed methods and procedures for predicting and safely drilling through shallow gas, permafrost and gas hydrates.

It would not be possible to carry out our regulatory responsibilities without a team of dedicated and competent individuals. I would like to take this opportunity to thank everyone within the organization for the excellent work they accomplished over the past decade.



Federal-Provincial-Territorial Management of the Frontier Lands

Offshore Accords

The federal government signed offshore accords with the Government of Newfoundland and Labrador in 1985 and the Government of Nova Scotia in 1986. Under these accords, the provinces have an equal say with the Government of Canada in the legislation and regulation of offshore petroleum activities.

To ensure a consistent regulatory regime throughout the frontier lands, the federal and provincial accord implementation acts incorporate provisions of the *Canada Petroleum Resources Act* and the *Oil and Gas Production and Conservation Act*.

Independent offshore petroleum boards were established to manage an offshore area on behalf of Canada and the province. The Canada-Newfoundland and the Nova Scotia Offshore Petroleum boards are under the authority of the federal and provincial energy ministers, who review fundamental decisions of the boards.

COGLA's role in implementing the accords is to facilitate the transfer of responsibilities to the boards and to provide advice and coordination on behalf of the federal energy minister.

Newfoundland and Labrador

In March Mobil Oil Canada Properties, on behalf of the Hibernia consortium, submitted its Hibernia Development Plan Update to the Canada-Newfoundland Offshore Petroleum Board (CNOPB). The update outlines a redesign of the Hibernia platform topside facilities. The board granted approval for the new design on August 15, 1990.

Throughout 1990, the Government of Canada, the Government of Newfoundland and Labrador and the Hibernia consortium negotiated intensively to finalize agreements for the Hibernia project. These negotiations culminated in an announcement on September 14, 1990, that an agreement had been reached between all parties for an immediate start to the Hibernia project. The *Hibernia Development Project Act* (Bill C-44) was proclaimed in November, and subsequently all agreements, including those on royalties, financing, industrial benefits and related matters, were signed.

In 1990 a memorandum of understanding (MOU) was signed, which sets out roles and responsibilities of CNOPB, and of government departments and agencies for industrial and employment benefits matters relating to the design and construction of offshore projects.

Nova Scotia

The *Canada–Nova Scotia Offshore Petroleum Resources Accord Implementation Act* was proclaimed December 22, 1989. Following proclamation of the provincial legislation on January 6, 1990, the Canada–Nova Scotia Offshore Petroleum Board (CNSOPB) was established and Fred V. Weir was appointed as chairman of the board.

LASMO Nova Scotia Limited and its partner, Nova Scotia Resources (Ventures) Limited submitted a development plan and a Canada–Nova Scotia Benefits Plan for the Cohasset-Panuke oil project to CNSOPB for approval. The board approved these plans, with conditions, in August and received the concurrence of the federal Minister of Energy, Mines and Resources and the provincial Minister of Mines and Energy in September. Initial production is projected to begin in 1992.

In July 1990, COGLA and CNSOPB signed an MOU on the curation of well materials and reports. At year-end, arrangements were being finalized to move the curation and laboratory facility to a new location in Dartmouth.

British Columbia

The federal and provincial governments continued to follow up on various accepted recommendations of the *West Coast Offshore Exploration Environmental Assessment Panel Report*. Federal and provincial officials also held discussions on a possible offshore petroleum resources accord. At year-end, the prohibitions on offshore petroleum exploration activity were still in effect.

Northwest Territories and Yukon

During 1990 the governments of the Northwest Territories and Yukon tabled proposals with the federal government for possible northern accords. COGLA provided technical assistance to the Department of Energy, Mines and Resources and the Department of Indian Affairs and Northern Development to help prepare the federal government's proposal. In the spirit of the 1988 agreements in principle on a northern accord between the Government of Canada and the territorial governments, COGLA consulted with officials of both territorial governments on its regulatory decisions in the North. COGLA also provided advice and information on regulation and management of oil and gas activities.

Rights Management

Under the authority of the ministers of Indian Affairs and Northern Development and Energy, Mines and Resources, COGLA issues, administers and registers licences that grant oil and gas exploration and production rights in Canada's North and in offshore frontier areas that are not under the jurisdiction of a regional board. COGLA also administers federally owned petroleum and mineral rights in the provinces, under the authority of the Minister of Energy, Mines and Resources.

Northwest Territories and Yukon

In March 1990 COGLA awarded three exploration licences (ELs) that resulted from a call for bids announced in late 1989. The three licences comprise about 110 000 ha in the central Beaufort Sea. Work expenditure bids for the three parcels totaled $5.2 million. One well must be drilled on each licence during the initial term for a second term to be granted. These licences, developed in cooperation with the two territorial governments, are the first new exploration rights issued in the Beaufort Sea in more than 20 years.

In April 1990 the Minister of Indian Affairs and Northern Development announced the call for nominations No. 2-1990 for lands in the western Beaufort Sea. This call, also developed with the two territorial governments, closed September 28, 1990. Despite earlier indications that industry was interested, no nominations were received.

In 1990 COGLA continued to consult industry, accord provinces, territorial governments and offshore boards on developing regulations under the *Canada Petroleum Resources Act* for royalties, surveys, Canadian ownership, and related guidelines, forms and procedures. COGLA also began preliminary assessments of proposed call for nomination areas elsewhere in the North.

Nova Scotia Offshore

The Canada–Nova Scotia Offshore Petroleum Board (CNSOPB) issued a call for bids in February 1990, for one parcel south of the Cohasset oil field. In early July the board announced the winning bid, comprising a work expenditure of $2.6 million. The successful bidder was awarded exploration licence EL-2100. The licence is for a six-year term consisting of two consecutive three-year periods. To be granted tenure during the second period, the holders must begin drilling a well before the end of the first period.

CNSOPB administered rights held under 5 ELs and 30 significant discovery licences (SDLs).

Newfoundland Offshore

In November the Canada-Newfoundland Offshore Petroleum Board (CNOPB) announced the winning bids in response to a call for bids issued in July for eight parcels. Seven parcels are off the west coast of Newfoundland. These exploration licences, which will be issued in 1991, will each have a nine-year term. The total minimum work expenditure for the seven parcels is more than $5.7 million. The eighth parcel, which has a work expenditure commitment of more than $5 million, is located southwest of the Terra Nova field. It has a seven-year term and requires a well in the initial four-year period. In all eight licences a well must be drilled in the first period to obtain tenure for the second period.

During the year, CNOPB issued 34 new SDLs and one production licence, and administered rights under 9 ELs, 43 SDLs and one production licence.

FRONTIER LAND HOLDINGS AT YEAR-END, 1986-1990

	1986	1987	1988	1989	1990
Number of Licences Active*	118	112	153	149	221
Lands Negotiated into Licences (millions of ha)	4.1	7.3	2.31	0.56	0.35
Lands Relinquished or Surrendered (millions of ha)	39.2	15.1	16.5	2.37	1.42
Lands Active (millions of ha)	33.5	20.6	7.1	5.69	4.6

** Includes exploration licences, significant discovery licences and production licences.*

LAND STATUS AT YEAR-END, 1990

	Active Licences*	Lands Relinquished or Surrendered (millions of ha)	Lands Negotiated into Licences (millions of ha)	Lands Active (millions of ha)	Pending Lands** (millions of ha)
Mainland Territories	45	0.4	0	0.6	1.1
Mackenzie Delta and Beaufort Sea	64	0.7	0.1	1.9	0
Arctic Islands and Eastern Arctic Offshore	23	0	0	1.29	2.4
Hudson Bay	0	0	0	0	1.4
Newfoundland Offshore	53	0.19	0.12	0.57	1.5
Nova Scotia Offshore (Includes Gulf of St. Lawrence)	36	0.13	0.13	0.24	3.4
West Coast	0	0	0	0	8.7
Total	**221**	**1.42**	**0.35**	**4.6**	**18.5**

** Includes exploration licences, significant discovery licences and production licences.*
*** 'Pending' includes areas where exploration activity has been suspended, for example: West Coast, Baffin Bay, Georges Bank, St. Pierre and Miquelon.*

LICENCES CONCLUDED IN 1990

Operating Company	Licence		Number of Licences*	Area (thousands of ha)	Location	Term (years)
Esso	EL	355/356	2	47.2	Beaufort Sea	8
Amoco	EL	357	1	63.6	Beaufort Sea	8
Paramount	PL	3	1	0.08	Mainland Territories	25
Mobil	SDL	1001/1002/ 1003/1005/ 1006	5	19.4	CNOPB	—
Petro-Canada	SDL	1004/1007/ 1009/1010/ 1032/1033	6	18.8	CNOPB	—
Husky	SDL	1008/1011/ 1017-1031/ 1034	18	55.4	CNOPB	—
Esso	SDL	1012-1016	5	6.0	CNOPB	—
Mobil	PL	1001	1	22.2	CNOPB	25
LASMO	EL	2100	1	24.9	CNSOPB	6
Shell	SDL	2120 A,B/ 2121/ 2276 A,B/ 2277/2298/ 2299 A	8	40.2	CNSOPB	—
Mobil	SDL	2254/ 2255 A-E 2255 J-N 2283 A-C	14	52.6	CNSOPB	—
Petro-Canada	SDL	2259	1	4.8	CNSOPB	—
Husky	SDL	2269/2286	2	4.8	CNSOPB	—
LASMO	SDL	2255 F-H/ 2299 B/2300	5	6.3	CNSOPB	—

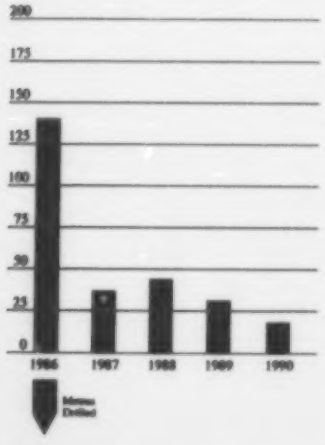
* *Includes exploration licences, significant discovery licences and production licences.*

Exploration Activity

In 1990, 15 wells were terminated on frontier lands. Exploration highlights included two significant oil and gas discoveries in the Mackenzie Delta–Beaufort Sea, and four new significant gas discoveries in the Cameron Hills area of the southern Northwest Territories.

Geophysical activity in 1990 was comparable to 1989 with an increase in activity in both the Newfoundland and Nova Scotia offshore areas. The Mainland Territories showed a decrease in activity.

Exploratory and Delineation Drilling on Frontier Lands
1986-1990
(thousands of m)



The North

In 1990, 14 of the 15 terminated wells on the frontier lands were in the North.

Mainland Territories

A total of 12 exploratory wells were terminated in 1990. In the Fort Good Hope area, Chevron Canada Resources Limited drilled four exploratory wells: Hume River I-66, N-10 and I-20, and Mountain River O-18. All wells were drilled to total depth, evaluated, plugged and abandoned.

In the Cameron Hills area, Paramount Resources Ltd. drilled five wells to total depth, one well was spudded and suspended for further drilling in 1991, and two wells drilled in previous years were reentered for further testing. Four of the five terminated wells were successful gas discoveries: Cameron A-68, J-37 and N-28, and Swede A-73. Paramount et al. Cameron L-44 was plugged and suspended for possible use as a water disposal well, and Paramount et al. Cameron B-25 was spudded at the end of the season and suspended because of spring breakup. It will be reentered next year and drilled to total depth. Paramount also reentered two wells for further testing: Cameron C-50, a 1986 gas discovery, and Cameron et al. L-47, a 1989 oil discovery. The other well in the area, Petro-Canada Swede E-02, was drilled to a depth of 1527 m and plugged and abandoned.

Two other wells in the southern Northwest Territories, Shell et al. Celibeta B-12 and PCI Island Lake N-45, were drilled to total depth, plugged and abandoned.

Geophysical activity decreased in 1990; only one seismic program and one gravity program were conducted. In the Fort Good Hope area, Amoco Canada Petroleum Company shot 181 km of seismic, and in the northwest Yukon, next to the U.S. border, Arco Alaska undertook a small

The Molikpaq *at the Isserk I-15 well location in the Beaufort Sea.*
Courtesy, Esso Resources Canada Limited.

gravity program. Four geological programs were undertaken. Chevron carried out two programs in the Fort Good Hope area; Arco ran one program in the northern Yukon, next to the U.S. border; and Amoco carried out one program in the Fort Simpson area.

Mackenzie Delta–Beaufort Sea

Two exploratory wells were drilled in 1990, one in the Beaufort Sea and one onshore in the Mackenzie Delta. Esso Chevron et al. Isserk I-15, in the central Beaufort Sea, was drilled from the *Molikpaq* mobile arctic caisson to a depth of 2693 m and tested oil and gas from several different zones. Onshore in the Mackenzie Delta, Shell Unipkat N-12 was drilled to a total depth of 1614 m and tested oil and gas from several zones.

Geophysical activity decreased substantially in this area, with only six programs conducted, including two site-specific surveys. Esso Resources Canada Limited completed two small reflection seismic surveys onshore Mackenzie Delta, and Geophysical Services Incorporated and Amoco each completed a marine seismic survey in the Beaufort Sea. Gulf Canada Resources Limited and BP Resources Canada Limited conducted site-specific surveys in the Beaufort Sea.

Arctic Islands and Eastern Arctic

No drilling took place in 1990. However, BP conducted a small geochemical survey in Baffin Bay.

East Coast Offshore

Geophysical activity increased noticeably in 1990, with 11 programs conducted. Drilling activity declined on the East Coast offshore, as only one exploratory well was drilled.

Newfoundland Offshore

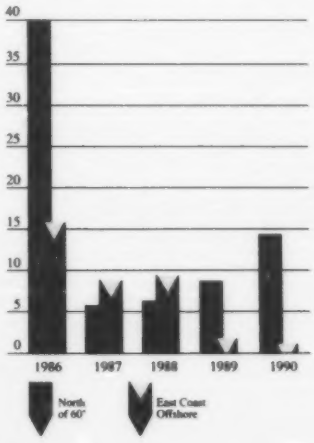
In 1990 four seismic programs were completed in the Jeanne d'Arc basin, totaling 5531 km. Shell Canada Limited and Petro-Canada Inc. each conducted a conventional two-dimensional seismic program, and Esso conducted a three-dimensional seismic program. Petro-Canada also carried out a site-specific survey. A small seismic program was also conducted on the western side of Newfoundland. BP conducted an airborne magnetometer survey and a site-specific survey.

The Petro-Canada et al. Kings Cove A-26 well was drilled southwest of the Terra Nova oil discovery using the *Sedco 710*. It was plugged and abandoned after reaching a total depth of 3092 m.

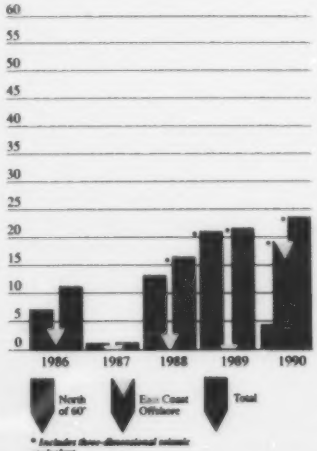
Nova Scotia Offshore

In 1990 three reflection seismic programs totaling 2731 km were run in the Sable Island area: two by LASMO and one by Mobil Oil Canada Ltd. In addition, LASMO conducted a site-specific survey near the Cohasset oil discovery. No wells were drilled in 1990.

Number of Wells Terminated
1986-1990



Reflection Seismic Shot on Frontier Lands
1986-1990
(thousands of km)



Resource Evaluation Activities

Evaluation of Hydrocarbon Potential

In 1990 COGLA worked with the Institute of Sedimentary and Petroleum Geology on two regional assessments of hydrocarbon potential: the part of the Western Canada Gas Assessment that extends into the Northwest Territories and Yukon to 62°N, and an assessment of the oil and gas potential of the Mackenzie corridor. Evaluation studies continued in the Beaufort Sea, contributing to the technical definition of the western Beaufort Sea call for nomination area.

As part of its contribution to land use planning in the North, COGLA reviewed the implications for exploration in the Mackenzie Delta–Beaufort Sea draft land use plan. COGLA also provided maps and supporting technical data to the Denendeh Regional Land Use Planning Commission for the Dene-Métis settlement area, and for the Keewatin regional land use plan in the Hudson Bay area. Evaluation work is also under way in the Old Crow flats and the Peel plateau areas of Yukon. The latter will contribute to the national park establishment process by Parks Canada and to the north Yukon regional land use plan.

Research

In 1989 COGLA awarded two contracts for research on organic geochemistry and biostratigraphy of samples from wells drilled with oil-based mud. The reports will be published in 1991.

As a member of the Pollution Prevention and Safety Panel for the *Ocean Drilling Program*, COGLA reviewed seismic data on proposed drilling locations throughout the world. COGLA also assessed potential drilling hazards and hydrocarbon accumulations at these locations.

Determination of Significant Discovery Areas

During 1990, a total of nine significant discovery areas (SDAs) were determined, including revisions to three previously declared SDAs.

In the southern Territories, four new SDAs were determined and three existing SDAs were enlarged based on the results of recent drilling in the Cameron Hills area by Paramount Resources Ltd. and Petro-Canada Inc. An SDA was determined for the Northcor et al. F-25A well near Fort Liard, NWT. In the Mackenzie Delta, a new SDA was determined for the Shell Unipkat N-12 discovery well.

Oil and Gas Committee

The Oil and Gas Committee is a quasi-judicial body that hears appeals and holds inquiries on technical matters relating to the *Oil and Gas Production and Conservation Act*. The committee also advises the Minister of Energy, Mines and Resources and the Minister of Indian Affairs and Northern Development on issues related to the *Canada Petroleum Resources Act*.

In 1990 the committee heard the first appeal on a recommended significant discovery declaration for the Esso et al. Minuk I-53 well in the Beaufort Sea.

An earlier appeal with respect to a proposed SDA for the Northcor et al. Liard F-25A discovery well, near Fort Liard, was withdrawn prior to being considered by the committee.

COGLA geologist in the field near Fort Simpson, NWT. Courtesy, T. Bird.

Conservation and Development

COGLA regulates the development and production of oil and gas in areas of the frontier lands not under accord legislation and ensures effective conservation of these valuable, nonrenewable resources.

Mainland Territories

Norman Wells

The performance of the waterflood project improved again over last year with increases in oil rates and reservoir pressure coupled with a decrease in the gas-oil ratio. Oil production in 1990 totaled 1.841 million m^3, an increase from 1.789 million m^3 in 1989. The daily average oil production rate increased to 5042 m^3 per day with the peak production being 166 843 m^3 in July. At year-end, cumulative oil production from the field was 13.99 million m^3. Gas production again decreased from the previous year, with 126 million m^3 produced compared with 129 million m^3 in 1989.

In October 1990 a new inlet separator and pump were installed at Norman Wells. The new inlet separators increased the plant's capacity to handle slugging. This occurs in pipelines that cross the Mackenzie River. The new pump raised the plant's total fluid handling capacity.

At year-end the well count was 155 injectors and 166 producers.

Kotaneelee

The Kotaneelee gas field in the southern Yukon produced intermittently in 1979-1980. In 1983 the plant was shut down. In 1990 COGLA granted approval to Columbia Gas Development of Canada Limited for major changes to the gas plant facilities. The modifications involve installing a monodiethanolamine system to remove hydrogen sulphide from the gas used in the generators and the plant. The existing waste gas incinerator was replaced with a new vapor recovery system and flare stack, improving efficiency and gas conservation at the plant. All the direct-fired process heaters and boilers were replaced with a centralized heat-medium system. The instrumentation and control systems were also upgraded.

The operator conducted workover operations on two wells in conjunction with the reactivation of the gas processing plant. The production zone in Columbia et al. Kotaneelee YT I-48, which had been inactive since 1979, was reperforated and new downhole equipment was installed. The Columbia et al. Kotaneelee YT B-38 well was tested and the status of the well was changed from suspended to producing. When the plant is operating, both wells will produce gas.

Pointed Mountain

Gas production from the Pointed Mountain gas field continued to decline, with 74 million m^3 produced in 1990, compared with 96 million m^3 produced in 1989. This brings the total cumulative field production to 8.155 billion m^3.

The Amoco Pointed Mountain G-62 well was reactivated and a gas compressor and dehydration unit, located at the well head, were installed. In August 1990 COGLA approved the operation of these new facilities.

Workover operations were carried out at the Columbia et al. Kotaneelee YT I-48 well site in the southern Yukon.

Cameron Hills

After a successful 1990 drilling season by Paramount, COGLA conducted a detailed petrophysical and hydrodynamic study to provide a preliminary estimate of reserve potential.

COGLA approved an extended flow test of the Paramount et al. L-47 well. The oil produced from the test was trucked from the Cameron Hills area to the Alberta pipeline network near Zama Lake.

Arctic Islands

Bent Horn

Panarctic Oils Ltd. made one shipment of crude from its Bent Horn oil field on Cameron Island. The *MV Arctic* left for Montreal with 24 684 m^3 of oil on September 8. Total field production for 1990 was 24 037 m^3, bringing the cumulative production at Bent Horn to 203 806 m^3.

Nova Scotia Offshore

Cohasset-Panuke

On July 17, 1990 LASMO applied for approval of a development plan based on the preliminary development plan submitted earlier during the year for the Cohasset-Panuke offshore oil fields. The simultaneous development of both fields will entail total production of 5.5 million m^3 of light crude oil. Seasonal production should begin in 1992. Production facilities that will be required include a wellhead jacket at each field connected by a subsea pipeline and a leased jack-up rig located at Cohasset. From the Cohasset production platform, the oil will be transferred to a storage tanker and then loaded on to a shuttle tanker. On August 8, 1990 the Canada–Nova Scotia Offshore Petroleum Board (CNSOPB) issued a decision report, which gave conditional approval for the development plan.

COGLA gave CNSOPB technical support on the certification process, reservoir simulation studies, geophysical and petrophysical analyses, and structural and facilities analyses.

The MV Arctic *at Bent Horn.*

Protection of the Worker

COGLA is responsible for ensuring, through the *Oil and Gas Production and Conservation Act* and parts of the *Canada Labour Code*, the health and safety of workers on frontier lands.

During 1990 COGLA, in consultation with representatives from the Nova Scotia and Newfoundland departments of Mines and Energy, and representatives from the Canada-Newfoundland and Canada–Nova Scotia Offshore Petroleum boards, completed work on proposals for safety amendments to the *Oil and Gas Production and Conservation Act*, and the corresponding sections of the Atlantic Accord and the Canada–Nova Scotia Accord Implementation acts. COGLA worked closely with the Department of Justice in preparing proposed amendments to the legislation. These amendments are the final statutory measures required to implement the balance of the recommendations from the Royal Commission on the *Ocean Ranger* Marine Disaster. The amendments will improve the protection of the worker by requiring that structures and equipment used by workers have certificates of fitness. Also, an installation manager must be present on the structure or facility to ensure the safety of personnel.

Drilling

In 1990 the Newfoundland Offshore Petroleum Drilling Regulations were published in Part 1 of *The Canada Gazette*. These regulations will be promulgated and published in Part 2 of *The Canada Gazette* in 1991. The Nova Scotia Offshore Petroleum Drilling Regulations were drafted and sent to the Department of Justice for legal examination. These regulations ensure that all measures affecting the safety of human life, the prevention of pollution of the natural environment and the conservation of hydrocarbon resources meet stringent standards before approval to drill is granted by the regulator.

Guidance notes for the Canada Oil and Gas Drilling Regulations, which apply to all areas under COGLA's jurisdiction, were completed and will be published in 1991. These notes serve as guidelines and information to operators to help them meet regulatory requirements. The information required to complete an application for approval of a well is described in detail. The document sets out current COGLA policy on survival suits, personnel training, standby vessels, contingency plans, relief well arrangements, environmental concerns and financial responsibilities.

Occupational Safety and Health

The Nova Scotia Petroleum Occupational Safety and Health (OSH) Regulations were written and sent to the Department of Justice for review. These regulations and the Newfoundland version will be promulgated in 1991. The regulations set out the measures and procedures that the petroleum industry must implement to ensure a safe and healthy workplace.

In 1990 the *Non-Smoker's Health Act* and associated regulations were passed. COGLA safety officers are responsible for enforcing the act and regulations, which prohibit smoking in all workplaces and accommodation areas at exploration and development sites. Specific rooms or areas may be designated for smoking if there is adequate ventilation.

Production

After extensive consultation with industry, the offshore petroleum boards and the accord provinces, the Canada Oil and Gas Production and Conservation Regulations were promulgated in November 1990. These regulations cover procedures and approvals for the orderly and efficient development and production of oil and gas discoveries on frontier lands. Under these regulations, the Development Plan Application Guidelines will be published in 1991. The Newfoundland and Nova Scotia offshore versions of these regulations were drafted and will be sent to the Department of Justice for review in 1991.

The 1988 Piper Alpha production installation disaster in the U.K. sector of the North Sea focused international attention on procedures for dealing with oil-field emergencies, firefighting and evacuation systems. COGLA has further improved the requirements in the draft Canada Oil and Gas Installations Regulations for structural fire protection, lifesaving equipment and firefighting equipment. In addition, the section of the draft regulations on the safety analysis of proposed installations was revised. This section now ensures that when designing the layout of proposed installations, the operator considers the safety of personnel in emergencies. Industry was consulted on these regulations, which will be submitted to the Department of Justice for review in 1991.

Geophysical

The Canada Oil and Gas Geophysical Regulations were completed in 1990 and sent to the Department of Justice for review. COGLA worked with the accord provinces and the offshore petroleum boards on the version of these regulations that apply to the East Coast offshore. These regulations apply to operators who conduct geophysical operations on the frontier lands. They establish standard procedures for obtaining authorization to conduct the program, and stipulate safe working practices, measures for protecting the environment and reporting requirements.

Safety Training

COGLA and other regulatory authorities worked with industry to develop the Canadian Offshore Petroleum Industry Qualifications, Safety Training and Certification (Drilling) Standard. This details the minimum safety, marine and industrial training required for each crew member of a mobile offshore drilling unit (MODU) and a standby vessel. The document also specifies the number and type of certified personnel required on board each type of drilling unit. These training standards were published in November 1990.

Diving

COGLA and the Canadian Association of Diving Contractors conducted a study that evaluated the Defence and Civil Institute for Experimental Medicine Diving Tables and the development of diving databases. The study provides a method for evaluating and determining safety margins of various decompression tables now used in commercial diving applications.

In 1990 COGLA received numerous applications for certifying divers and diving-related personnel interested in working in the Canadian offshore. COGLA carefully reviewed these applications according to the requirements of the Canada Oil and Gas Diving Regulations. More than 50 personnel were certified during the year.

Shallow Drilling Hazards

In 1990 COGLA organized and chaired a workshop in Calgary on shallow drilling hazards in the Mackenzie Delta–Beaufort Sea. Northern operators and invited experts attended the workshop. This workshop was recommended to operators in COGLA's 1989 report on the Immiugak N-05 blowout incident. The workshop reviewed and assessed methods and procedures for predicting and safely drilling through shallow gas, permafrost and gas hydrates. Participants came to some agreement on procedures and equipment requirements for drilling through these hazardous zones. Workshop proceedings were published and sent to participants and potential explorers. Operators are encouraged to consult these proceedings when planning drilling programs in this area.

Workers installing ice load measurement sensors at the Isserk I-15 well site in the Beaufort Sea.
Courtesy, Esso Resources Canada Limited.

In 1990 COGLA encouraged the development of an annular control tool with northern operators. This tool minimizes the risk of a shallow blowout by immediately sealing off the annulus when gas is encountered, thereby preventing flow from reaching the unit's rig floor. A prototype has been developed and tested successfully. This tool will enhance well control at shallow depths, increasing safety for the drill crew.

Floating Vessel Blowout Control

In conjunction with other national authorities and 15 major worldwide operators, COGLA participated in a joint industry-government project studying blowout control from a floating vessel. The study addresses the problems of developing new technology for shallow blowout control, for relief well intervention and for controlling pollution emanating from a deep-water blowout. The project was 70 per cent completed at year-end and the final report is expected in May 1991. The report will help formulate contingency plans for floating MODUs and will identify the areas where technological development is necessary.

Lost-Time Accidents

COGLA established a hazardous occurrence report database in 1990 for employees working at exploration and development sites. This database will contain historical information on accidents on the frontier lands. The

database will help to determine which OSH regulations need changes.

In 1990, no lost-time accidents (LTAs) occurred at drill sites on the frontier lands, resulting in a significant reduction in the incidence rate of LTAs from the 18.6 per million person-hours worked recorded last year. However, a total of four production and workover related LTAs were reported to COGLA safety inspectors. There were no fatalities associated with oil and gas activities on the frontier lands during the year.

Inspections

COGLA officials inspect exploration and production sites to ensure that operations are conducted according to approved program and regulatory requirements. In 1990 a total of 21 drilling, 3 production facilities and 2 geophysical inspections were conducted.

Research and Development

Research and development is an integral part of COGLA's activities. Environmental conditions on frontier lands require that new technologies be developed, assessed and implemented or that established technologies be adapted to these unique conditions.

Under the Interdepartmental Panel on Energy Research and Development (PERD), COGLA chairs the Task 6.2 Marine Engineering Committee, and serves on the geoscientific, offshore geotechnics, materials, transportation and environment committees. Through these committees, COGLA promotes studies in personnel safety, environmental protection, structures engineering, ice-structure interaction and environmental design criteria. The major projects sponsored by PERD and managed by COGLA are described below.

Evacuation Technology

During the year, various innovations in evacuation technology were reviewed to assess their applicability to operating conditions on Canada's East Coast. To give rig workers as many evacuation options as possible, the report recommended that research be conducted on improving the facilities for dry evacuation of personnel from the drilling platform to the standby vessel. As a result, a follow-up project was initiated to design a way of transferring personnel. The design includes a constant-tension line between the rig and the standby vessel; personnel can use various available appliances to evacuate down the line.

Protection of Submarine Pipelines from Ice Scour

The safe design and operation of pipelines in the Arctic and Newfoundland offshore requires an understanding of how ice scouring can threaten the integrity of a pipeline. The results of a comprehensive study evaluating the possible effects of ice scouring on a pipeline were presented at an international workshop entitled *Ice Scouring and the Design of Offshore Pipelines*. The workshop was cosponsored with the Centre for Cold Ocean Resources Engineering. The recommendations from the workshop are being used to determine future priorities in ice scour and pipeline design research.

Ice-Structure Interaction

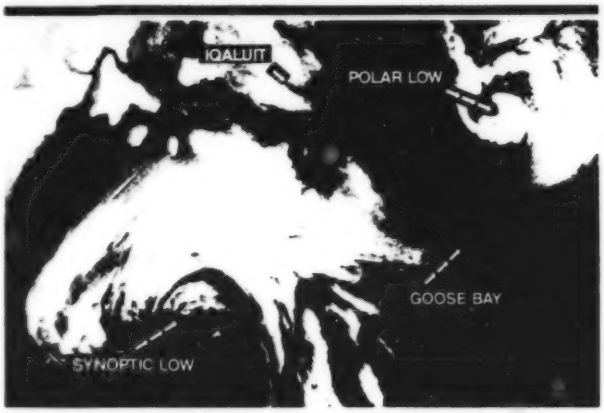
COGLA chairs an advisory committee that directs ice-structure interaction research for PERD Task 6.2. Research in this area is directed to collecting ice-load field data and developing numerical processes that can be used for assessing ice-structure interaction. The 1990 field program included participating in a joint industry program at Isserk I-15 in the Beaufort Sea, to measure ice loads, rubble field stability and ice movement. The results will be used to evaluate structures in the landfast ice zone of the Beaufort Sea.

Safety inspectors routinely carry out inspections of oil and gas operations on the frontier lands.

The advisory committee is also sponsoring a major effort to develop *new ice-structure interaction models*. The initial phase of this project was completed and four contractors developed ice-load models. The study's objective is to better understand the interaction process and to improve methods for calculating ice loads on Arctic structures.

Polar Lows

COGLA sponsored a project to investigate the occurrence, frequency and behavior of polar lows over Canadian waters. As part of the project, the Atmospheric Environment Service of Environment Canada gave presentations on the prediction and climatology of these rapidly developing storms at all major forecast offices throughout Canada. These presentations sensitized forecasters to these phenomena and will help them predict these storms. Canadian numerical weather prediction models were also prepared to improve the forecasting of these storms. A forecaster's handbook for predicting polar lows will be published at the end of the project. The ability to predict these storms will enhance the safety and efficiency of operations in the offshore.



A satellite picture of a polar low off the northeast coast of Labrador
Courtesy, Atmospheric Environment Service.

LOST-TIME ACCIDENTS ON FRONTIER LANDS, 1990

	Person-Hours at Work Site		Lost-Time Accidents		Accident Rate	
	Drilling Unit	Standby/ Supply Vessel	Drilling Unit	Standby/ Supply Vessel	Drilling Unit	Standby/ Supply Vessel
					(LTA/Millions of Person-Hours)	
Mainland Territories*	109 858	—	0	—	0	—
Mackenzie Delta and Beaufort Sea*	25 352	—	0	—	0	—
Arctic Islands and Eastern Arctic Offshore	—	—	—	—	—	—
Newfoundland Offshore	106 392	46 056	0	2	0	43.4
Nova Scotia Offshore	—	—	0	—	—	—
Total	**241 602**	**46 056**	**0**	**2**		

* *Estimated.*

Protection of the Environment

East Coast

In 1990 COGLA conducted four major environmental reviews on proposed development projects in the East Coast offshore. Three reviews were on the Hibernia development project, offshore Newfoundland, and one review was on the Cohasset-Panuke development project, offshore Nova Scotia.

Hibernia

In March 1990 Mobil Oil Canada Properties and its joint venture partners (the consortium) submitted a revised development plan, the Hibernia Development Plan Update, to the Canada-Newfoundland Offshore Petroleum Board. COGLA coordinated a federal interdepartmental environmental review of the update. In August, based on the review by COGLA and comments received from other departments, COGLA recommended to the Minister of Energy, Mines and Resources (EMR) that the project proceed, since no significant adverse environmental or social effects were identified at this stage of the project.

In late 1989, the consortium selected Bull Arm on Trinity Bay as the preferred platform construction site. Because this site had not previously been examined, COGLA coordinated an environmental screening with other federal government departments according to the federal Environmental Assessment and Review Process (EARP). In August 1990, COGLA recommended to the EMR minister that the project proceed since the potential adverse environmental and directly related social effects were deemed to be insignificant or mitigable with known technology.

Marystown Shipyard Limited (MSL) submitted a proposal to construct and operate the Cow Head Offshore Fabrication Complex as an extension to its existing oil rig servicing facility at Cow Head, Mortimer Bay. The expansion will allow MSL to bid on metal fabrication contracts associated with the Hibernia development project and other future offshore developments. Since the expansion project received federal funding from the Offshore Development Fund, EARP guidelines required that a federal environmental assessment be carried out. COGLA coordinated a federal departmental review of the project. In November, after receiving advice from other government departments, COGLA recommended to the EMR minister that the project proceed because potential adverse environmental and social effects were deemed to be insignificant.

Cohasset-Panuke

To meet EARP requirements, COGLA coordinated the federal departments' environmental review of the Cohasset-Panuke development plan project application.

Part of the review involved examining public submissions made to the Cohasset-Panuke Environmental and Socio-Economic Review Commission and the commission's report. J.R. (Pat) Ellis chaired the commission. In September COGLA recommended to the EMR minister that the project proceed because it would not have any significant effect on the environment, if the measures recommended by the commission were incorporated in the development plan.

West Coast

As a member of the Pacific Environmental Coordinating Committee, COGLA helped fund and develop a computer-based coastal resource sensitivity information system. This system has been completed and, when fully developed, will be a useful tool in identifying environmental sensitivities for offshore coastal areas.

North

Kulluk *Public Review*

In March 1989 Gulf Canada Resources Ltd. submitted a project description for its proposed *Kulluk* drilling program 1990-1992 to the Environmental Impact Screening Committee according to the terms of the Inuvialuit Final Agreement. The Gulf project was referred to the Environmental Impact Review Board (EIRB) for a more detailed environmental assessment and review because of concerns for contingency planning and countermeasures in the event of an oil spill.

Following public hearings in June in Inuvik, EIRB recommended to COGLA that the application be rejected. EIRB felt that neither the proponent nor the government were prepared to effectively handle an oil spill in the Beaufort Sea. EIRB also noted that it had insufficient

documentation for assessing the aggregate financial liability that would accrue if a worst-case oil well blowout occurred. The report outlined numerous other concerns related to the primary reasons for its recommendation. COGLA published its observation on the EIRB report in the publication, *Observations on the EIRB's June 29, 1990 Decision Report on Gulf Canada Resources Ltd. Proposed* Kulluk *Drilling Program.*

To resolve the various long-term issues raised by the application, the Minister of Indian Affairs and Northern Development established the Beaufort Sea Steering Committee. R. Hornal, a consultant familiar with northern environmental issues, chairs the committee. The steering committee members include representatives from Beaufort Sea petroleum operators, Inuvialuit and government agencies. Seven subcommittees were established to address the issues raised in the EIRB report. The steering committee was asked to prepare recommendations for the minister based on the results of the subcommittees.

Cleanup Technology Workshop

In November, COGLA, in cooperation with the Beaufort Sea Oil Spill Cooperative, sponsored an Inuvik workshop on cleanup technology as part of a long-term program to promote contingency planning awareness in the North. More than 60 participants from northern communities, government and the oil industry discussed the current state of preparedness, technical capability and logistical problems that relate to oil spill cleanup. It is intended that during 1991, meetings will be convened to formalize community representation in the contingency planning and response team structure.

Land Use Planning

COGLA provided environmental information to the Mackenzie Delta–Beaufort Sea, Denendeh and Nunavut Regional Land Use Planning commissions. The Minister of Indian Affairs and Northern Development and the NWT Minister of Renewable Resources approved the Lancaster Sound Regional Land Use Plan in November 1990, and the responsibility for this planning region has now been assumed by the Nunavut Planning Commission. COGLA also helped the Kluane and North Yukon Land Use Planning commissions in Yukon formulate land use plans for land users.

Environmental Studies Research Funds

COGLA continued to administer the Environmental Studies Research Funds (ESRF). These funds are special levies on the oil and gas industry that are used to conduct research studies. The studies help industry and government make environmental and social decisions on oil and gas activities on Canada's frontier lands.

Offshore oil skimmer and boom. Courtesy, S. Gill.

The 1990 program budget was almost double that of 1989 and is now more than one million dollars. ESRF is currently funding 14 studies covering topics from geoscience investigations and physical environment studies, to effects of oil on marine species and marshlands. Some studies conducted in 1990 are described below.

Repetitive Mapping of Ice Scours

These studies quantify depth and frequency of scour trenches left by icebergs and pressure ridge keels on the seafloor. This information will affect the design of structures, such as subsea pipelines and wellheads. Studies have been funded for the Grand Banks and Beaufort Sea areas.

Geoscience Issues Related to Gas Developments in the Mackenzie Delta

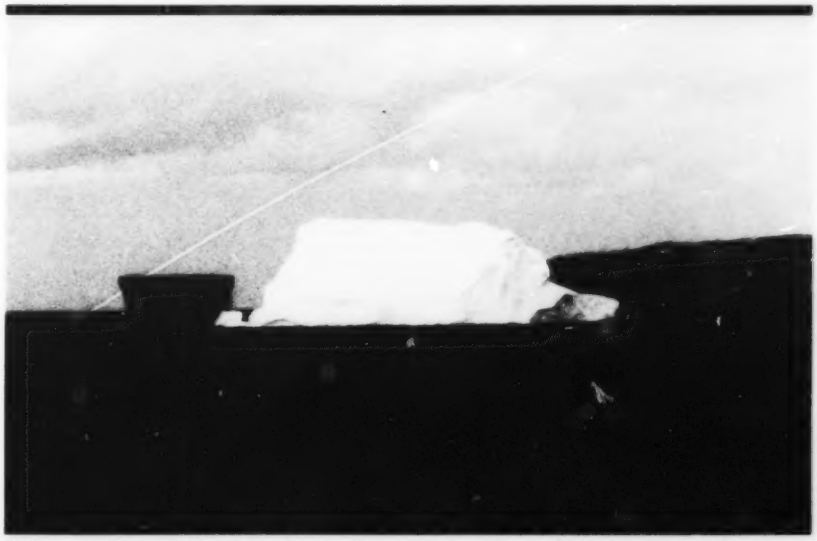
This study covers a range of field studies for improving the understanding of geothermal and geotechnical conditions of the delta. Field investigations emphasize geothermal and permafrost stability, active geomorphic processes and ground ice distribution. The results have a direct bearing on the design of facilities that may be used to exploit the petroleum resources of the area.

Iceberg Trajectory Modeling

This study tests an existing iceberg trajectory simulation program with operational data in a real-time environment. The information provided by the test could help develop a prediction system that could improve the iceberg management activities associated with exploration and development on the Grands Banks and Labrador offshore areas.

Mackenzie Delta–Beaufort Nearshore Overwintering Fisheries Habitat

This study investigates and develops a database of the distribution of fish species overwintering near the Mackenzie Delta. This information will be used to minimize any environmental effects of exploration and development activities on important fish species and stocks overwintering in the area.



Icebergs are frequently the subject of research to ensure the safety of offshore personnel who are working on drilling rigs.

Employment and Industrial Benefits

COGLA is responsible for promoting full and fair access for Canadians to industrial benefits and employment opportunities that may arise from oil and gas exploration, development and production activities on Canada's frontier lands.

Onshore and offshore oil and gas activities created 2464 jobs in 1990. In the North, 1571 jobs were created; all but two jobs were filled by Canadians. On the East Coast, Canadians filled 729 jobs out of a total of 893.

In 1990 foreign business groups and governments continued to express interest in the opportunities in Canada's offshore development. Many groups came to Canada to learn more about these opportunities; others formed joint ventures with Canadian companies. COGLA gave a presentation on Canada's oil and gas potential, with emphasis on East Coast developments and related business opportunities, to the Canada-Norway Offshore Working Group.

Northern Developments

In March 1990 a call for bids for parcels of lands in the central Beaufort Sea resulted in three exploration licences. The call gave the federal, NWT and Yukon governments an opportunity to work together on benefits matters, as called for in the 1988 agreements in principle on a northern accord. The territorial governments will monitor northern benefits; the federal government will monitor national benefits. With few exceptions, benefits for northern exploration programs are domestic, since expenditures and labor are concentrated in western Canada and in the North.

East Coast Developments

COGLA officials assisted Energy, Mines and Resources in negotiating the benefits provisions of two project agreements: the Hibernia oil project offshore Newfoundland and the Cohasset-Panuke oil project offshore Nova Scotia.

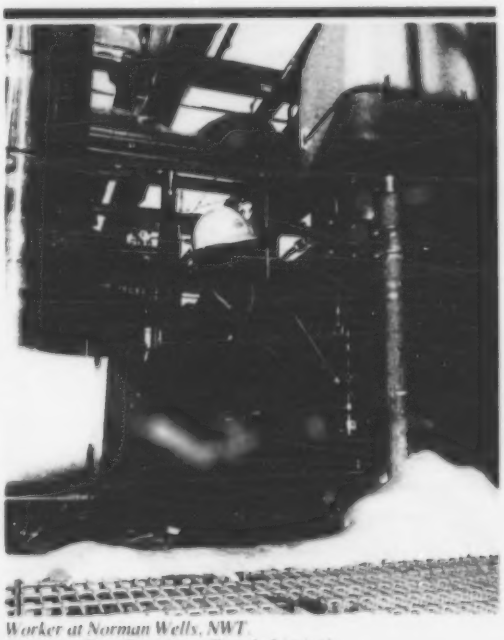
Hibernia

As the first major offshore development project in Canada, Hibernia will generate significant new business opportunities for companies in Newfoundland and Labrador, and in other parts of Canada. Hibernia is one of the largest and most technologically complex petroleum projects ever undertaken by the petroleum industry. It is expected to be a major force in strengthening existing Canadian capabilities and in fostering new ones.

In the final Hibernia agreement, the Hibernia consortium estimated a Canadian content level of 55 to 60 per cent of the $5.2 billion pre-production capital expenditures during project development, and a Canadian employment level of 66 per cent. The consortium also estimated that 85 to 90 per cent of the person-hours for total project management and for engineering design of the gravity base structure, topside and the offshore oil-loading facilities will take place in Canada. After production begins, an additional $3.3 billion in capital expenditures will be spent to fully develop the field. Operating phase expenditures are estimated to total $10 billion over the projected 18-year production life of the oil field.

Cohasset-Panuke

This project involves the development of two oil fields located near Sable Island, offshore Nova Scotia, using conventional offshore technology similar to that used in the Gulf of Mexico. The Canadian content level for the Cohasset-Panuke project during the development stage is estimated to be 70 per cent of the $160 million capital expenditures, while Canadian employment level is expected to be around 70 per cent. The forecast for Canadian content and employment levels during the production stage are estimated at 40 per cent and 85 per cent respectively.



Worker at Norman Wells, NWT
Courtesy, Esso Resources Canada Limited.

TOTAL 1990 PETROLEUM-RELATED EMPLOYMENT ON FRONTIER LANDS

	Total Work Force*	Canadian	Per Cent Canadian
Mainland Territories**	619	619	100
Mackenzie Delta and Beaufort Sea**	922	921	99.9
Arctic Islands and Eastern Arctic Offshore**	30	29	97
Newfoundland Offshore	747	587	79
Nova Scotia Offshore	146	142	97
Total	**2 464**	**2 298**	**93**

* *Represents approximate number of jobs created.*
** *Jobs in the North are seasonal.*

TOTAL 1990 PETROLEUM EXPENDITURES ON FRONTIER LANDS

	Exploration*	Development	Production**	Total	Canadian	Per Cent Canadian***
	(millions of $)					
Mainland Territories	29.1	—	—	29.1	27.6	95
Mackenzie Delta and Beaufort Sea	35.5	—	—	35.5	30.2	85
Arctic Islands and Eastern Arctic Offshore	—	—	—	—	—	—
Newfoundland Offshore	36.1	—	—	36.1	28.2	78
Nova Scotia Offshore	4.5	—	—	4.5	3.1	68
Total	**105.2**	**—**	**—**	**105.2**	**89.1**	**85**

* *Includes geophysical expenditures.*
** *In 1990, pre-production expenditures for the Hibernia and Cohasset-Panuke development projects totaled $58.8 million and $18.5 million respectively.*
*** *Estimates.*

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Frontier Lands

Statistical Summary

ACTIVITY STATUS ON FRONTIER LANDS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs) Concluded	23	42	105	15	70
Wells Spudded	60	48	25	12	13
Metres Drilled	150 404	67 234	54 391	27 014	18 903
Wells Terminated	70	50	27	10	15
Discoveries	14	1	2	4*	6
Geophysical Programs Run	15	7	27	21	19
Reflection Seismic km	11 001	2 756	16 568	21 587	23 684
Rig-Months	133	41	37	18	16

* *Includes revision to 1989 COCLA Annual Report.*

FRONTIER LANDS RESOURCE INVENTORY, 1990	OIL*		GAS	
	Discovered (millions of m^3)	Potential	Discovered (billions of m^3)	Potential
West Coast	0	50	0	270
Mainland Territories	37.7	95	35.5	312
Mackenzie Delta and Beaufort Sea	240.7	1 112	356.6	1 918
Arctic Islands and Eastern Arctic Offshore	65.7	873	416.4	3 156
Hudson Bay	0	127	0	88
Newfoundland Offshore	287.4	894	162.5	1 649
Nova Scotia Offshore	23.7	318	164.7	663
Total	**655.2**	**3 469**	**1 135.7**	**8 056**

* *Includes condensate.*

OIL AND GAS PRODUCTION ON FRONTIER LANDS	1986	1987	1988	1989	1990
Oil Production (thousands of m^3)					
Norman Wells	1 411	1 531	1 728	1 789	1 841
Bent Horn	17.5	34.5	54.9	43.4	24
Amauligak	50	—	—	—	—
Panuke	—	3.7	—	—	—
Gas Production (millions of m^3)					
Pointed Mountain	205	156	154	96*	74
Norman Wells	188	163	138	129	126

* *Includes revision to previous estimates.*

Mainland Territories

Statistical Summary

ACTIVITY STATUS	1986	1987	1988	1989	1990
Wells Spudded					
Exploratory/Delineation	14	1	3	6	11
Development	14	35	11	—	—
Total	**28**	**36**	**14**	**6**	**11**
Wells Terminated*					
Exploratory/Delineation	14	2	3	4	12
Development	14	36	11	—	—
Total	**28**	**38**	**14**	**4**	**12**
Metres Drilled	36 289	31 132	15 778	9 865	14 197
Exploratory/Delineation	24 401	974	7 095	9 865	14 197
Development	11 888	30 158	8 683	—	—
Geophysical Programs Run	7	5	9	9	2
Reflection Seismic km	2 095	149	1 729**	1 600	181

* *In the Mainland Territories, where exploratory operations are generally restricted to the winter months, a well is deemed to be terminated in the year in which it reaches total depth, even though it may be reentered in the following year for testing.*

** *Includes three-dimensional seismic equivalent.*

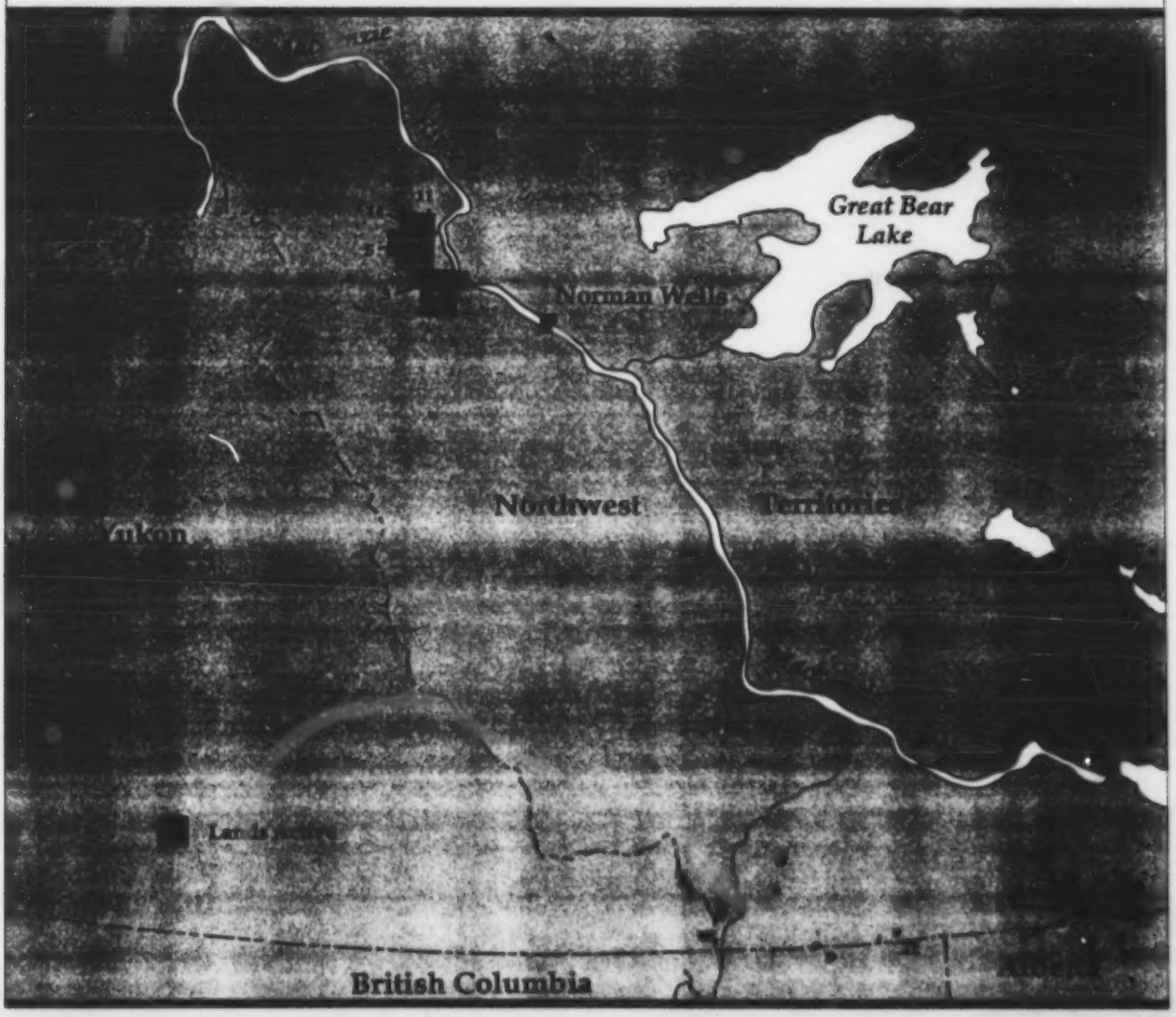
RESOURCES STATUS	1986	1987	1988	1989	1990*
Discovered Resources**					
Gas (billions of m^3)	20.3	20.8	20.8	21.8	35.5
Oil (millions of m^3)	51.0	37.2	37.2	37.7	37.7
Gas and Oil Production					
Pointed Mountain Gas (millions of m^3)	205	156	154	96*	74
Norman Wells Gas (millions of m^3)	188	163	138	129	126
Norman Wells Oil (thousands of m^3)	1 411	1 531	1 728	1 789	1 841

* *Includes new discoveries and revisions to previous estimates.*

** *As reported in previous years.*

BENEFITS STATUS	1986	1987	1988	1989	1990
Rigs Active	11	3	3	5	6
Rig-Months	33	13	6	5	10
Money Spent (millions of $)					
Geophysical/Geological	11.1	2.4	8.7	12.6	2.8
Exploratory/Delineation Drilling	54.1	4.4	6.3	11.5	26.3
Development Drilling	14.3	27.0	5.3	—	—
Production Facilities	5.6	30.5	5.3	—	—
Total Money Spent (millions of $)	**85.1**	**64.3**	**25.6**	**24.1**	**29.1**

LAND STATUS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs) Concluded	0	24	18	0	1
Total ELs/SDLs Active	**30**	**29**	**30**	**25**	**45**
Lands Negotiated into ELs/SDLs/PLs (millions of ha)	0	4.5	0.08	0	0
Lands Relinquished/Surrendered (millions of ha)	3.3	4.7	0.9	0.38	0.4
Lands Active (millions of ha)	5.7	2.3	1.2	0.9	0.6



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Paramount et al. Cameron C-50	60°09'04"N 117°38'41"W	*Cactus 21*	86-03-09 86-03-26		
			Flint Rig 771	90-02-08 90-02-15	Plugged & suspended	1 569
2.	Paramount et al. Cameron L-47	60°06'32"N 117°39'19"W	*Sierra 2*	89-02-11 89-03-06		
			Roll 'n Rig 31	89-03-12 89-04-02		
			*	90-02-07 90-03-25	Plugged & suspended, oil discovery	1 565
3.	Chevron et al. Mountain River O-18	65°37'58"N 129°02'29"W	*Shehtah 1*	89-11-30 90-01-08	Plugged & abandoned	1 120
4.	Paramount et al. Cameron L-44	60°03'32"N 117°39'03"W	*Sierra 2*	89-12-29 90-01-20		
			Flint Rig 771	90-02-23 90-03-08	Plugged & suspended	1 634
5.	Chevron et al. Hume River I-66	65°55'34"N 129°41'39"W	*Shehtah 1*	90-01-17 90-02-09		
			Shehtah 4	90-02-24 90-03-01	Plugged & abandoned	745
6.	PCI Swede E-02	60°11'26"N 117°31'25"W	*Hi-Tower 2*	90-01-19 90-02-17	Plugged & abandoned	1 527
7.	Paramount et al. Cameron A-68	60°07'06"N 117°26'17"W	*Sierra 2*	90-01-21 90-02-12		
			Flint Rig 706	90-03-14 90-03-25	Plugged & suspended, gas discovery	1 575
8.	Paramount et al. Swede A-73	60°12'10"N 117°43'27"W	*Sierra 5*	90-01-31 90-02-25		
			Flint Rig 771	90-03-09 90-03-18	Plugged & suspended, gas discovery	1 585
			*	90-03-18 90-03-25		
9.	Shell Celibeta B-12	60°01'13"N 122°17'43"W	*Peter Bawden 20*	90-02-01 90-03-24	Plugged & abandoned	1 659

Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
10.	Paramount et al. Cameron J-37	60°06'36"N 117°36'26"W	*Sierra 2*	90-02-13 90-03-10		
			Flint Rig 771	90-03-19 90-03-27	Plugged & suspended, gas discovery	1 576
11.	Chevron East Hume River N-10	65°59'58"N 129°15'59"W	*Shehtah 1*	90-02-16 90-03-04	Plugged & abandoned	445
12.	PCI Island Lake N-45	60°04'56"N 120°53'34"W	*Nabors 7*	90-02-21 90-03-14	Plugged & abandoned	1 450
13.	Paramount et al. Cameron N-28	60°07'59"N 117°35'08"W	*Sierra 5*	90-02-26 90-03-19		
			Flint Rig 706	90-03-26 90-03-28	Plugged & suspended, gas discovery	1 592
14.	Chevron East Hume River I-20	65°59'28"N 129°17'17"W	*Shehtah 1*	90-03-12 90-03-24	Plugged & abandoned	365
15.	Paramount et al. Cameron B-25	60°04'05"N 117°34'41"W	*Sierra 2*	90-03-20 90-03-23	Plugged & suspended	394

* *Tested through separator.*

In 1990, abandonment operations were completed for the following wells:

Pan Am et al. A-1 Kotaneelee YT P-50
Sun Netla C-07
Home Silt Lake H-64

Workover operations were conducted at the following sites:

Columbia et al. Kotaneelee YT B-38
Columbia et al. Kotaneelee YT I-48
Columbia et al. Kotaneelee YT M-17

Mackenzie Delta and Beaufort Sea

Statistical Summary

ACTIVITY STATUS	1986	1987	1988	1989	1990
Wells Spudded					
Exploratory/Delineation	17	3	3	5	1
Wells Terminated*					
Exploratory/Delineation	24	3	4	4	2
Metres Drilled					
Exploratory/Delineation	48 016	8 344	13 438	11 273	1 614
Geophysical Programs Run	5	1	7	10	6
Reflection Seismic km	4 756	139	11 475**	19 483**	4 371

* *In the Beaufort Sea, where operations are seasonal and could take place over a number of seasons for a given well, a well is deemed to be terminated in the year in which it reaches total depth.*

** *Includes three-dimensional seismic equivalent.*

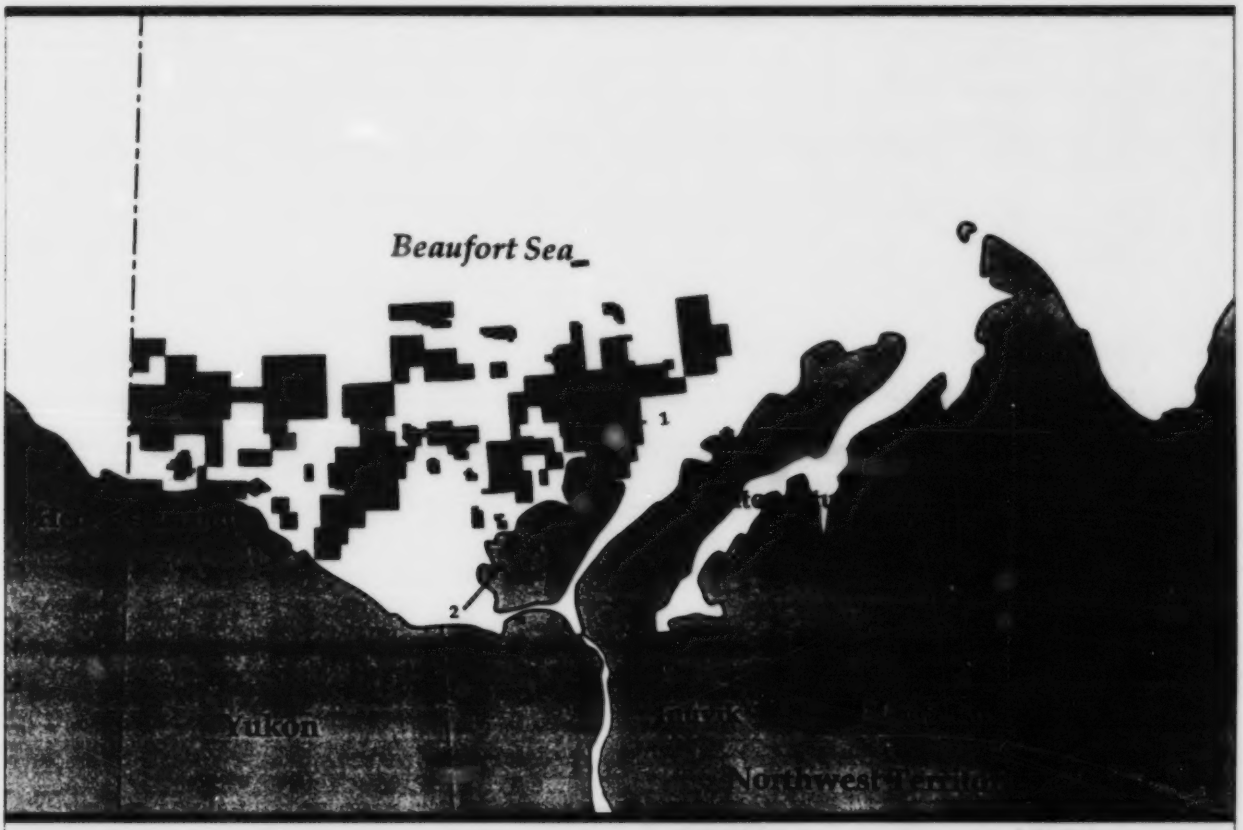
RESOURCES STATUS	1986	1987	1988	1989	1990*
Discovered Resources**					
Gas (billions of m^3)	292.8	302.1	308.5	322.7	356.6
Oil (millions of m^3)	193.2	253.2	253.2	256.4	240.7
Oil Production					
Amauligak (thousands of m^3)	50.4	—	—	—	—

* *Includes new discoveries and revisions to previous estimates.*

** *As reported in previous years.*

BENEFITS STATUS	1986	1987	1988	1989	1990
Rigs Active	11	3	2	4	2
Rig-Months	43	5	10	9	2
Money Spent (millions of $)					
Geophysical/Geological	14.6	0.2	27.6	36.6	16.6
Exploratory/Delineation Drilling	391.5	108.6	99	196.6	18.9
Total Money Spent (millions of $)	**406.1**	**108.8**	**126.6**	**233.2**	**35.5**

LAND STATUS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs)					
Concluded	0	11	49	7	3
Total ELs/SDLs/PLs Active	**23**	**28**	**59**	**62**	**64**
Lands Negotiated into ELs/SDLs/PLs (millions of ha)	0	2.1	1.4	0.2	0.1
Lands Relinquished/Surrendered (millions of ha)	3.1	1.4	2.1	1.4	0.7
Lands Active (millions of ha)	4.2	2.9	3.4	2.5	1.9



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Esso Chevron et al. Isserk I-15	69°54'44"N 134°17'57"W	*Molikpaq*	89-11-11 90-01-08	Plugged & abandoned, oil & gas discovery	2 693
2.	Shell Unipkat N-12	69°11'55"N 135°19'08"W	*Atco/Equtak 76*	90-02-06 90-04-04	Plugged & suspended, oil & gas discovery	1 614

Arctic Islands and Eastern Arctic Offshore

Statistical Summary

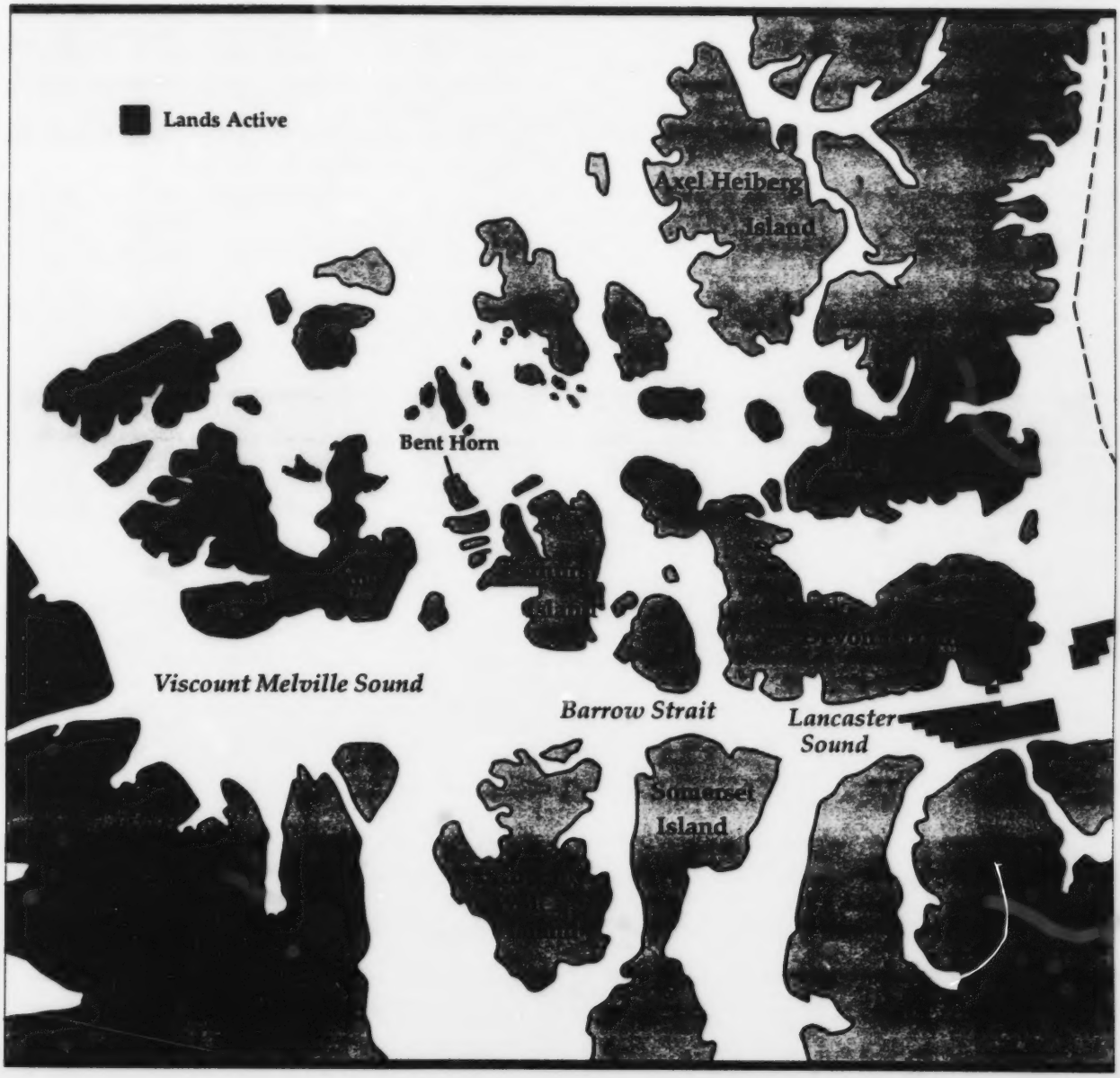
ACTIVITY STATUS	1986	1987	1988	1989	1990
Wells Spudded					
Exploratory/Delineation	2	1	0	0	0
Wells Terminated					
Exploratory/Delineation	2	1	0	0	0
Metres Drilled					
Exploratory/Delineation	4 940	689	0	0	0
Geophysical Programs Run	0	0	0	0	0
Reflection Seismic km	0	0	0	0	0

RESOURCES STATUS	1986	1987	1988	1989	1990
Discovered Resources*					
Gas (billions of m^3)	416.4	416.4	416.4	416.4	416.4
Oil (millions of m^3)	65.7	65.7	65.7	65.7	65.7
Oil Production					
Bent Horn (thousands of m^3)	17.5	34.5	54.9	43.4	24.0

* *As reported in previous years.*

BENEFITS STATUS	1986	1987	1988	1989	1990
Rigs Active	2	1	0	0	0
Rig-Months	4	2	0	0	0
Money Spent (millions of $)					
Geophysical/Geological	0	0	0	0	0
Exploratory/Delineation Drilling	34.5	8.3	0	0	0
Production Facilities	0.6	0.5	0	0	0
Total Money Spent (millions of $)	**35.1**	**8.8**	**0**	**0**	**0**

LAND STATUS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs)					
Concluded	1	3	24	0	0
Total ELs/SDLs/PLs Active	**21**	**16**	**30**	**24**	**23**
Lands Negotiated into ELs/SDLs/PLs (millions of ha)	0.9	0.3	0.4	0	0
Lands Relinquished/Surrendered (millions of ha)	8.9	5.9	0.6	0.17	0
Lands Active (millions of ha)	7.5	1.6	1.4	1.29	1.29


Lands Active
Axel Heiberg Island
Bent Horn
Viscount Melville Sound
Barrow Strait
Lancaster Sound
Somerset Island

Appendix I

Nova Scotia Offshore

(including the Gulf of St. Lawrence)

1990 data verified by the Canada–Nova Scotia Offshore Petroleum Board.

Statistical Summary

ACTIVITY STATUS	1986	1987	1988	1989	1990
Wells Spudded					
Exploratory/Delineation	6	3	1	0	0
Wells Terminated					
Exploratory/Delineation	8	3	1	0	0
Metres Drilled					
Exploratory/Delineation	29 744	9 583	5 208	0	0
Geophysical Programs Run	2	1	2	1	4
Reflection Seismic km	613	195	0	504	2 731*

* *Includes three-dimensional seismic equivalent.*

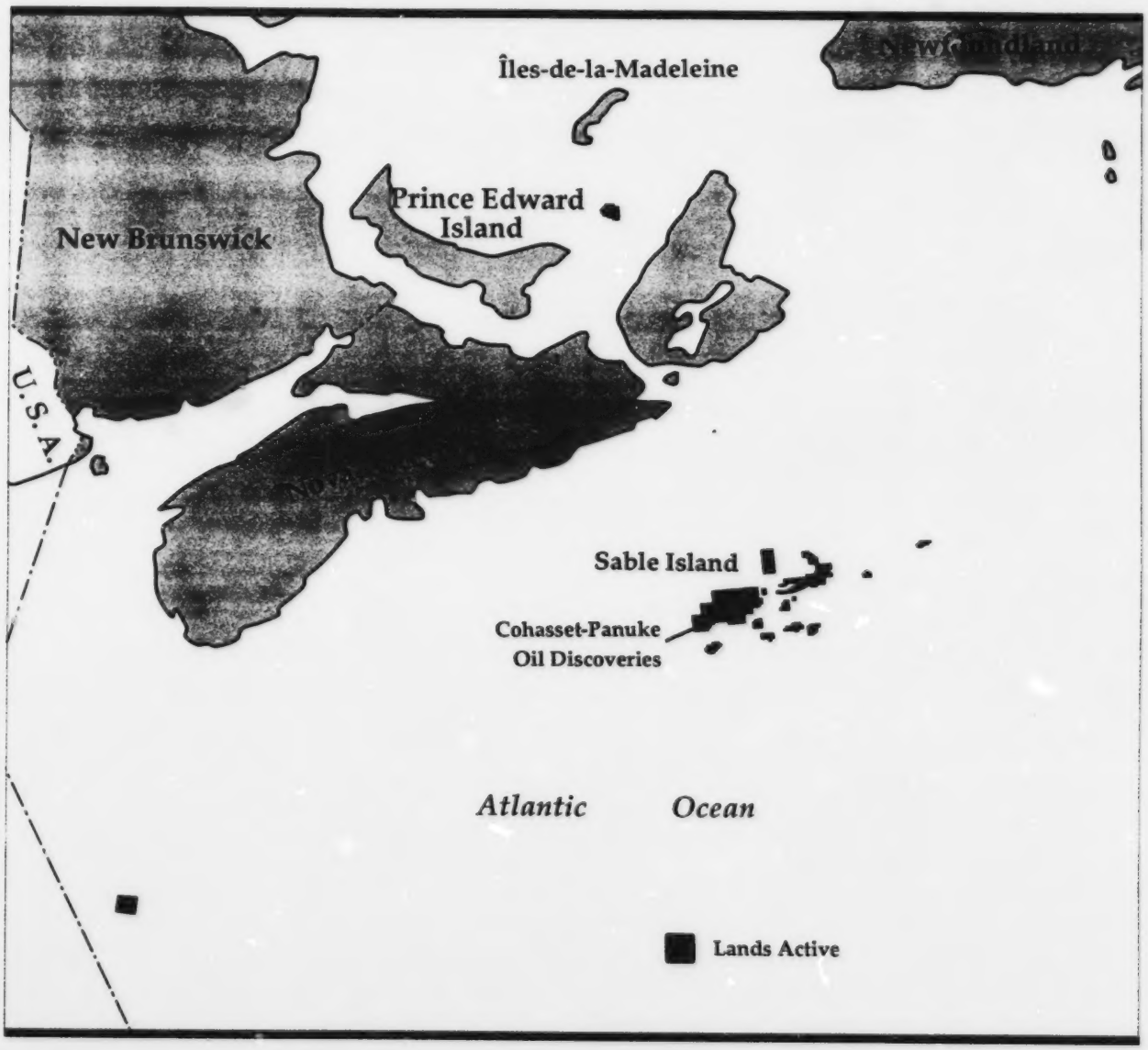
RESOURCES STATUS	1986	1987	1988	1989	1990*
Discovered Resources**					
Gas (billions of m^3)	150.6	160.9	162.4	164.7	164.7
Condensate and Oil (millions of m^3)	22.1	22.9	22.9	23.7	23.7
Oil Production (thousands of m^3)					
Panuke	—	3.7	—	—	—

* *Includes new discoveries and revisions to previous estimates.*
** *As reported in previous years.*

BENEFITS STATUS	1986	1987	1988	1989	1990
Rigs Active	5	2	1	0	0
Rig-Months	22	5	4	0	0
Money Spent (millions of $)					
Geophysical/Geological	0.9	0.2	0.2	0.7	4.5*
Exploratory/Delineation Drilling	176.8	35.3	31.5	0	0
Total Money Spent (millions of $)	**177.7**	**35.5**	**31.7**	**0.7**	**4.5**

* *In 1990, pre-production expenditures for the Cohasset-Panuke development project was $18.5 million.*

LAND STATUS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs)					
Concluded	13	3	1	3	31
Total ELs/SDLs/PLs Active	**15**	**17**	**15**	**17**	**36**
Lands Negotiated into ELs/SDLs/PLs (millions of ha)	1.7	0.3	0.04	0.1	0.13
Lands Relinquished/Surrendered (millions of ha)	3.2	1.1	0.4	0.12	0.13
Lands Active (millions of ha)	1.1	0.7	0.3	0.24	0.24


Îles-de-la-Madeleine
Prince Edward Island
New Brunswick
U.S.A.
Sable Island
Cohasset-Panuke Oil Discoveries
Atlantic Ocean
Lands Active

Appendix II

Newfoundland Offshore

1986-1990 data verified by the Canada-Newfoundland Offshore Petroleum Board.

Statistical Summary

ACTIVITY STATUS	1986	1987	1988	1989	1990
Wells Spudded					
Exploratory/Delineation	7	5	7	1	1
Wells Terminated					
Exploratory/Delineation	8	5	8	2	1
Metres Drilled					
Exploratory/Delineation	31 415	17 486	19 967	5 876	3 092
Geophysical Programs Run	1	0	9	0	7
Reflection Seismic km	3 537	0	3 364	0	16 401*

* *Includes three-dimensional seismic equivalent.*

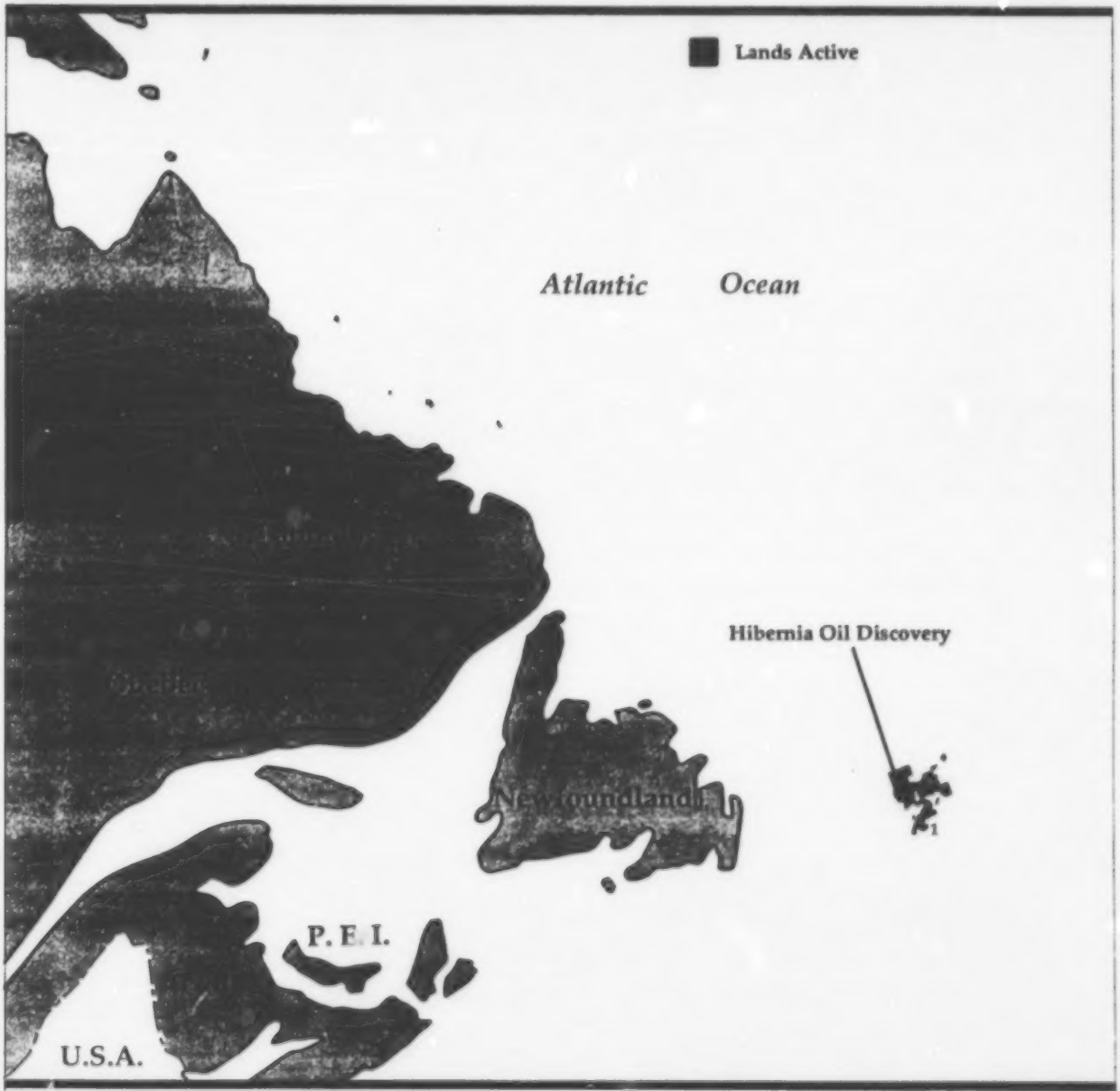
RESOURCES STATUS*	1986	1987	1988	1989	1990**
Discovered Resources***					
Gas (billions of m^3)	146.8	146.8	146.8	148.7	162.5
Oil and Condensate					
(millions of m^3)	176.5	181.0	212.0	235.2	287.4

* *These figures have been generated by COGLA and may differ from those published by CNOPB.*
** *Includes new discoveries and revisions to previous estimates.*
*** *As reported in previous years.*

BENEFITS STATUS	1986	1987	1988	1989	1990
Rigs Active	6	2	2	1	1
Rig-Months	31	16	17	4	4
Money Spent (millions of $)					
Geophysical/Geological	4.1	0	5.2	0	10.4*
Exploratory/Delineation Drilling	347.0	200	154.6	29.4	25.7
Total Money Spent (millions of $)	**351.1**	**200**	**159.8**	**29.4**	**36.1**

* *In 1990, pre-production expenditures for the Hibernia development project totaled $58.8 million.*

LAND STATUS	1986	1987	1988	1989	1990
Licences (ELs/SDLs/PLs)					
Concluded	9	1	12	5	35
Total ELs/SDLs/PLs Active	**27**	**21**	**19**	**21**	**53**
Lands Negotiated into ELs/SDLs/PLs					
(millions of ha)	1.5	0.1	0.1	0.26	0.12
Lands Relinquished/Surrendered					
(millions of ha)	9.2	1.8	1.0	0.3	0.19
Lands Active					
(millions of ha)	3.4	1.7	0.8	0.76	0.57



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Petro-Canada et al. King's Cove A-26	46°25'09"N 48°33'07"W	*Sedco 710*	90-03-06 90-06-17	Plugged & abandoned	3 092

Glossary

Abandoned Well: Any well that has been permanently plugged.

Annular Control Tool: A device designed to shut off the well flow before it reaches the surface.

Annulus: The space between the drill pipe and a casing string or between the drill pipe and the open hole.

Benefits Plan: A plan submitted by operators and approved by the minister that states the employment and procurement intentions of operators related to their exploration and development activities on frontier lands.

Biostratigraphy: The science of correlating rock units based on the fossil assemblages they contain.

Blowout: The uncontrolled flow of gas, oil, water or other fluid from a well.

Call for Bids: A notice published in *The Canada Gazette* or other publication, whereby the minister calls for the submission of bids in relation to Crown reserve lands.

Call for Nominations: A notice inviting interested parties to nominate tracts of lands for potential inclusion in a call for bids.

Completed Well: A well that has been drilled and equipped so that it is capable of producing oil or gas.

Cubic Metre of Gas: Equivalent to 35.301 cubic feet at 14.73 pounds per square inch (760 mm of Hg) of atmospheric pressure at sea level.

Cubic Metre of Oil: Equivalent to 6.2898 American stock tank barrels.

Development Plan: A plan that describes the approach and facilities that the proponent intends to use to recover hydrocarbon resources based on the proponent's interpretation of geology and reservoir characteristics of a field.

Dry Evacuation: Evacuation without requiring personnel to enter the water, e.g., evacuation by helicopter.

Exploration Licence: A licence granting the right to explore for, and the exclusive right to drill and test for, petroleum, and the exclusive right to obtain a production licence subject to compliance with the other provisions of the *Canada Petroleum Resources Act*.

Exploration Well: A well drilled on a geological feature where no significant discovery has previously been made (synonymous with wildcat well).

Gas Hydrate: A crystalline substance composed of water and methane that exists at low temperatures.

Geotechnics: The field of science that deals with the physical and mechanical properties of soil and rock for engineering purposes.

Gravity Survey: A type of geophysical program that measures variations in the gravitational field of the earth and relates them to the densities of various rock types. This enables the form and thickness of a sedimentary basin to be determined.

Hectare (ha): 10 000 square metres (equivalent to 2.47 acres).

Hydrocarbon: A naturally occurring compound consisting primarily of atoms of hydrogen and carbon, in solid, liquid or gaseous form.

Hydrodynamic: Of or relating to the force or pressure of water or other fluids.

Ice Scour: Seabed features such as trenches, gouges and tracks, which result from the contact of moving ice masses with the seabed.

Injection Well (Injector): A well in which fluids are injected into an underground formation to increase reservoir pressure.

Landfast Ice: Sea ice that forms and remains attached to the shore.

Magnetometer Survey: A geophysical technique that measures intensity of the earth's magnetic field over an area. Variations in this intensity are related to mineralization or differing rock types both on the surface and in the subsurface.

Mobile Arctic Caisson: An annular steel caisson (better known as the *Molikpaq*), with deck dimensions of 75 m x 73 m, which is designed to be set down on an underwater berm.

Mobile Offshore Drilling Unit (MODU): Any vessel capable of engaging in drilling operations for the exploration for, or the exploitation of, resources beneath the seabed.

Overwintering: To pass the winter.

Petrophysical: Dealing with the relationship of rock types and parameters such as porosity to measurements obtained from down-hole wireline logs.

Polar Lows: Intense atmospheric storms that develop deep within cold air masses streaming over warm water surfaces. Relatively small in scale (i.e., less than 500 km), they develop rapidly and often generate gale force winds, which at times may reach storm force or higher.

Pressure Ridge Keels: Portions of consolidated or unconsolidated ice rubble formations extending downward below an ice pressure ridge.

Reflection Seismic: The primary geophysical technique used in petroleum exploration for mapping subsurface geological features. Acoustic pulses created at the surface are reflected from layers that have different acoustic properties within the earth. The pulses are recorded at the surface for processing and interpretation.

Rights Issuance: The process of granting industry rights to Crown reserve lands subject to the *Canada Petroleum Resources Act*.

Shallow Gas: Gas encountered in the early stage of drilling a well, before the installation of surface blowout prevention equipment.

Significant Discovery: A discovery indicated by the first well on a geological feature that demonstrates by flow testing the existence of hydrocarbons in that feature and suggests the existence of an accumulation that has potential for sustained production.

Slugging: A nonhomogenous flow of gas and liquids.

Spud: To start the drilling of a well.

Suspended Well: A well in which drilling or production operations have temporarily ceased.

Terminated Well: A well that has reached total depth and has been abandoned, completed or suspended.

Waterflood: A method of recovery in which water is injected into a reservoir to remove additional quantities of oil from the reservoir.

Work Expenditure: Actual cost of exploration activities.

COGLA Offices

Region	Mailing Address	Street Address	Telephone	Telecopier
Headquarters	15th Floor, Tower B 355 River Road Vanier, Ontario K1A 0E4	14-16th Floor, Tower B 355 River Road Vanier, Ontario	(613) 993-3760	993-9897
Maritimes	Core Storage and Laboratory 2nd Floor 201 Brownlow Ave. City of Lakes Industrial Park Dartmouth, Nova Scotia B3B 1W2	Core Storage and Laboratory 201 Brownlow Ave. Suite 27 City of Lakes Industrial Park Dartmouth, Nova Scotia	(902) 426-3179	426-2628
Northwest Territories	P.O. Box 1500 Yellowknife, N.W.T. X1A 2R3	Bellanca Building 4914-50th Street 6th Floor Yellowknife, N.W.T.	(403) 920-8175	873-8707
Western	3rd Floor 630-4th Ave. SW Calgary, Alberta T2P 0J9	Merland Building 630-4th Ave. SW 3rd Floor Calgary, Alberta	(403) 292-5631	292-4491